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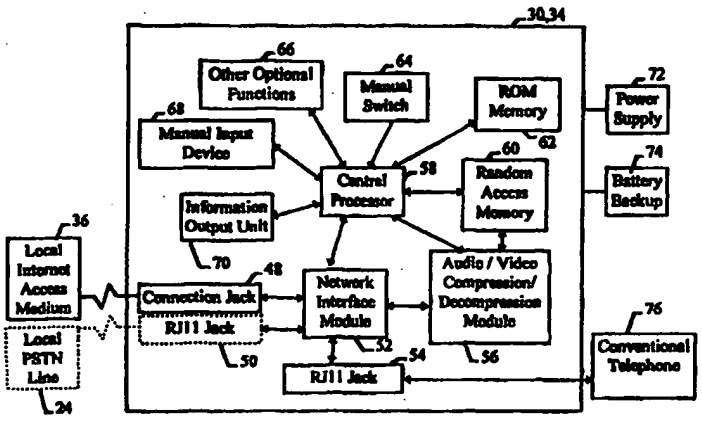

(57) Abstract

A dedicated appliance for packet-switched voice communication is provided with a mechanism to ensure that both the caller and a recipient of voice communication having a similar appliance have a connection to the packet-switched network. Such an appliance eliminates the need for complex and expensive multimedia computer systems and Internet telephony software which requires a pre-existing network connection for both parties prior to initiating communication. In one embodiment of the invention, a caller's appliance may cause a recipient's appliance to connect to the packet-switched network through the access medium of the recipient. Another mechanism which enables switching between circuit-switched and packet-switched voice communication allows for both kinds of communication to be used by the same appliance. Once connected to the network, the caller and recipient may establish a connection therebetween over the packet-switched network to permit communication. Network service providers (NSP) which provide access to the packet-switched networks for users do not need to dedicate connection ports to voice communication and therefore can allow use of any connection port for any purpose with the existing infrastructure.

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DEDICATED SYSTEM AND PROCESS FOR DISTRIBUTED COMMUNICATION ON A PACKET-SWITCHED NETWORK

Field of the Invention

The present invention is related to communication over packet-switched networks. The present invention is more particularly related to voice communication using such networks.

Background of the Invention

Voice communication typically uses a circuit-switched network. Such a network is maintained by regional and long distance telecommunication carriers, and typically provides a dedicated channel for each connection established between subscribers for voice communication. A circuit-switched network is expensive to operate, which in turn causes users to incur significant charges, particularly for long distance calls. Additionally, each connection requires a direct path between two locations, typically determined using a complex algorithm. Additionally, each connection is recorded for billing purposes. The overhead incurred for billing is a substantial portion of the cost in maintaining the network.

Recently there has been an increased interest in the use of packet-switched networks for voice communication. In particular, a global network of computers using a packet-switched network. commonly known as the Internet, has been the platform for some computer software that allows for voice communication between two or more individuals connected to the Internet.

Because packet-switched networks are less expensive to use and more versatile than circuit-switched networks, there is an increasing interest in developing their use for voice and video communication. However, there are some drawbacks to packet-switched networks. First, packet-switched networks are used primarily for general data communication. At present, it generally does not guarantee reliable real-time performance, particularly for voice communication. The lack of reliable real-time communication results in degradation of the quality of voice data transmitted over the network. These problems will eventually be overcome as technology and communication standards develop. A second problem is that both users who wish to communicate by voice over a packet-switched network have to have operative connections to the network. It is not possible at the present time to initiate voice communication over the packet-switched network without each party establishing their own connection to the network prior to communication being initiated by one of the parties. This requirement is in stark contrast to the circuit-switched networks where the recipient of a conventional telephone

call is notified, for example, by ringing of a telephone.

Some current proposals for using packet-switched networks for telephone communication either are computer software (e.g., the Internet Phone software from VocalTec of Northvale, New Jersey and the WebPhone software by Netspeak of Boca Raton, Florida) which are loaded onto a general purpose multimedia computer system with a modem or use centralized systems known as "hop-off" servers which translate between packet-switched data packets and electronic voice signals expected by a circuit-switched network and which generate outgoing phone calls through a regular telephone network (also called a plain old telephone system (POTS)). Some of the problems with the first kind of computer software are that the cost, complexity, and inconvenience of using the computer and the software is significant. To receive incoming calls, the computer system needs to be continuously, on wasting much electricity, and needs to have a continuous link to the Internet which can incur online charges from an access provider. Furthermore, the computer system uses much of the computer's central processor power that could otherwise be used for increasing performance on other software applications. The problem with the second kind of system is that it has operations costs similar to those associated with circuit-switched networks for general-purpose consumer and business use. In particular, current service providers to the Internet might have to dedicate bandwidth and connection ports for the sole purpose of providing voice communication and these dedicated servers are not useful for other kinds of data communication. Additionally, it is becoming increasingly likely that individual consumers may have one or more means to access the packet-switched network via various media such as cable television lines, optical fibers, wireless, digital subscriber lines, other than telephone lines. Having such versatility to easily switch among several options to conduct voice communication through any of these media would benefit consumers and businesses.

Summary of the Invention

A dedicated appliance for packet-switched voice communication is provided with a mechanism to ensure that both the caller and a recipient of voice communication having a similar appliance has a connection to the packet-switched network. Such an appliance eliminates the need for complex and expensive multimedia computer systems and Internet telephony software which requires a pre-existing network connection for both parties prior to initiating communication. In one embodiment of the invention, a caller's appliance may cause a

recipient's appliance to connect to the packet-switched network through the access medium of the recipient. Another mechanism which enables switching between circuit-switched and packet-switched voice communication allows for both kinds of communication to be used by the same appliance.

Once connected to the network, the caller and recipient may establish a connection therebetween over the packet-switched network to permit communication. Network service providers (NSP) which provides access to the packet-switched networks for users do not need to dedicate connection ports to voice communication and therefore can allow use of any connection port for any purpose with the existing infrastructure.

Accordingly, one aspect of the invention is a communication system using a packet-switched network. The communication system includes a first network access system for providing access to the packet-switched network. A second network access system also provides access to the packet-switched network. A first appliance has a mechanism for connecting to the first network access system through a first access medium, and sends and receives packets through this connection to the packet-switched network. A second user appliance has similar capabilities. In addition, the second user appliance has mechanisms for causing the first appliance to connect to the packet-switched network through the first network access system. The first and second appliances then can send and receive packets to and from one another through the packet-switched network.

Another aspect of the invention is an appliance for communication using a packet-switched network. The appliance connects to a first access medium, and in turn connects to a first network access system connected to the packet-switched network using the access medium. The appliance includes a mechanism for causing another appliance to be connected, through a second access medium, to a second network access system connected to the packet-switched network. After the connection of the other appliance is made, the two appliances may send and receive packets through the packet-switched network to each other.

In one embodiment of the invention, the first appliance is caused to connect to the packet-switched network by first connecting with the first appliance using a public switched telephone network (PSTN) encompassing a local exchange carriers (LEC) and an inter-exchange carrier (IXC) then instructing the first appliance to connect to the first network access system using its access medium. In another embodiment of the invention, the first appliance is caused to connect to the packet-switched network by the second appliance dialing the first appliance using PSTN

and then having the first appliance use the caller identification service of the LEC to connect to the first network access system using its access medium. In another embodiment of the invention, the first appliance is caused to connect to the packet-switched network by the second appliance identifying the first network access system and then by instructing the first network access system to connect with the first appliance through the access medium connected to the first appliance. In another embodiment of the invention, the first appliance is caused to connect to the packet-switched network by the second appliance identifying and instructing the first network dial-out service provider to inform the first appliance to connect through the access medium connected to the first appliance. In yet another embodiment, the first appliance is continuously connected to the first network access system and is caused to connect to the packet-switched network by the second appliance. In any embodiment of the invention, the appliance also way initiate any conventional calls using the PSTN.

Another aspect of the invention, which may be used in combination with other aspects of the invention, is a database system for storing information supporting a communication system using a packet-switched network, wherein first and second appliances are connected through first and second access media to first and second network access systems which are connected to the packet-switched network. The database stores user information for each of the first and second appliances, such as a first unique identifier indicating an address for the appliance accessible using the packet-switched network and a second unique identifier indicating an access mechanism for establishing a connection over an access medium between the first and second network access systems and the first and second appliances. The database responds to queries to return one of the first and second unique identifiers as well as any other pertinent user information.

In another aspect of the invention, an appliance selects whether a conventional telephone call is made or whether the call is made over the packet-switched network. In another aspect of the invention, the connection to the packet-switched networks made after the identifier of the recipient is input to the appliance by the caller.

Brief Description of the Drawings

In the drawings,

Fig. 1 is a block diagram of a voice communication system in accordance with the present invention;

Fig. 2a is a more detailed block diagram of one embodiment of the telephone appliance shown in Fig. 1;

Fig. 2b is a more detailed block diagram of another embodiment of the telephone appliance shown in Fig. 1;

Fig. 3 is a more detailed block diagram of the central database (CBD) shown in Fig. 1;

Fig. 4 is a more detailed diagram of the dedicated communication facility (DCF) as shown in Fig. 1;

Fig. 5a is a flow chart of one embodiment of a process for making an Internet telephone call using the voice communication system of the present invention;

Fig. 5b is a flow chart of another embodiment of a process for making an Internet telephone call using the LEC caller identification service with the voice communication system of the present invention;

Fig. 6a is a flow chart of an embodiment of a process for using the voice communication system of the present invention using dial-out possibilities with existing network service providers;

Fig. 6b is a flow chart of another embodiment of a process for using the voice communication system of the with dedicated dial-out service providers;

Fig.7 is a flow chart of an embodiment of a process for using the voice communication system of the present system with a continuous link to a packet-switched network;

Fig. 8 is a flow chart describing the process to check if a recipient's telephone number has an appliance.

Fig. 9 is a flow chart describing how the telephone appliance contacts a local Internet service provider to establish a PPP/SLIP link;

Fig. 10 is a flow chart describing how the central database is updated;

Fig. 11 is a flow chart describing how the recipient's dedicated communication facility makes an outgoing telephone call;

Fig. 12 is a flow chart describing query processing in the central database;

Fig. 13 illustrates an example information packet for the central database; and

Fig. 14 is a diagram illustrating an example data portion of a packet containing one or more type length and value entities.

Detailed Description

The present invention will be more completely understood through the following detailed description which should be read in conjunction with the attached drawing in which similar reference numbers indicate similar structures.

Referring now to Fig. 1, the voice communication system of the present invention is shown in comparison to a conventional voice communication system. A conventional system includes a conventional telephone 20 connected to a telephone network 22. The telephone network 22 includes a local exchange carrier (LEC) 24 connected to an inter-exchange carrier 26 (IXC) (i.e., long distance carrier) and a second LEC 28. The network 22 allows users of conventional phone 20 to contact a recipient using conventional telephone 20' over long distances. In one embodiment of the present invention, an appliance 30, described in more detail below, is used to access a packet-switched network 32, such as the Internet, to contact a recipient having another similar appliance 34 or any compatible systems abiding to International Telecommunications Union (ITU) multimedia communications standards for packet-switched communication, such as H.320, H.323 and H.324. While the invention is described herein with reference to the Internet, it should be understood that it is generally applicable to any packet-switched protocols and networks that allow for packet-switching capabilities, included but not limited to, TCP/IP, IPX, ATM, Ethernet, ISDN, and PSTN, using a variety of communications standards, including, but not limited to, ITU standards H.320, H.323 and H.324. The network 32 is accessed by appliances 30 and 34 via network access media 36 and 38. Such access may be provided over several possible access media. Such access media include, but are not limited to POTS, cable television cable lines, electric power lines, optical fibers, wireless, satellite, digital subscriber lines, etc. The term "access media" as used herein is intended to mean any mechanism for access to the network, whether analog, digital, optical or wireless. The access media allow access to a public or private network service provider 40 or 42 such as an Internet service provider, which may be local to each user. The network service providers 40 and 42 access a packet-switched network 44, such as a large global network, commonly called the Internet, and have access to a central database 46, described in more detail below, of users of the appliances 30 and 34 or an otherwise compatible system which may utilize such a database.

Using the conventional communications network 22, the user 20 typically has access charges incurred for access to the local telephone company, and per call access charges due to a long distance carrier that supports the public switched telephone network. In the present

invention, the users of appliances 30 and 34 typically incur charges for obtaining access through a local network access medium 36 and 38 such as the local telephone company and/or a network service provider 40 and 42.

The appliance 30, 34 will now be described in connection with Figs. 2a and 2b. One form of packaging of the appliance may be a separate box that connects between a connector to the network access medium and a conventional telephone 76 for which the circuitry is shown in Fig 2a. This form of packaging may be integrated with other appliances such as cable television converter boxes and high-definition digital televisions to provide integrated telephony services using cable Internet access or video telephony using a small window image on a high-definition television (HDTV) set.

Another form of packaging of the appliance may be like a conventional telephone for which the circuitry shown in Fig. 2b is same as in Fig. 2a except for numeric keypad 66', handset with a transmitter 78 (e.g., microphone) and receiver 80 (e.g., speaker), and an integrated conventional telephone interface electronics 77. Yet another form of packaging could be a single household model for allowing all phones connected to the main household phone line to use Internet telephony.

The appliance has an Internet access jack 48 to permit connection to a network service provider. The Internet access jack can also accommodate other network connections depending on the network access medium such as coaxial cable connector for cable access or a conventional phone jack such as an RJ-11 connector if connecting to an LEC via a POTS modem. If the connection jack 48 is not a conventional phone jack, a conventional phone jack 50 such as an RJ11 jack can be made available for connection to the PSTN line for making conventional calls. Such means of network and phone connection allows the appliance to function just like a regular phone for local phone calls, but for long-distance phone calls, which may be detected by examining the telephone number of the appliance users from the central database 46, it may connect automatically into the network, if there is an appliance user corresponding to the telephone number, or into an IXC if there is no appliance user corresponding to the telephone number.

The appliance does not require both parties to be already linked to the network to initiate communication. At least five modes of operation may be provided for establishing a connection with the recipient. One mode uses a conventional long-distance telephone call to cause the recipient's appliance 34 to initiate a connection with its own network service provider, as

described in more detail below. A second mode causes the recipient's appliance to connect with its own network service provider by using caller identification of the caller as described in more detail below. A third mode causes the network service provider local to the recipient to initiate the connection with the recipient, as described in more detail below. A fourth mode causes a network dial-out service provider local to the recipient to initiate the connection with the recipient as described in more detail below. A fifth mode causes the caller's appliance to directly connect to the recipient's appliance with a continuous connection to the network service provider as described in more detail below. These modes of operation may be compatible with each other depending on the available type of network access by each of the calling parties. The software for causing these operation modes can also be adapted for running on conventional computer systems running on various operating systems for example Unix, Microsoft's Windows, IBM OS/2, and Apple operating system.

The appliance 30, 34 in Fig.2a and 2b shows two possible embodiments of the invention. The appliance 30, 34 includes a network interface module 50 and 50' such as a POTS modem for establishing communication with the network access medium 36 through connection jack or port 48, a central processor, a random access memory 60 and 60', digital signal processor chip 56 and 56' to conduct dedicated audio and/or video compression and decompression, a manual input device 68 and 68' such as a keypad, and an information output unit 70 and 70' such as an LCD display and/or voice messaging software system directly to a receiver 80' or to the handset of a conventional telephone 76 to inform the appliance user of any necessary status or decision requests.

A power supply 72 and 72' provides power to the appliance 30 and a back-up battery 74 and 74' maintains operation during a power outage. Other features 66 and 66' may also be included such as those for data encryption and decryption, speaker phone, caller ID, call waiting, conferencing, and voice mail. A manual switch 64 and 64' or software setup change allows for switching between operation modes, of which three are described in more detail below. The appliance operates in full-duplex mode to allow both parties to talk at once.

The central processor unit 58 and 58' may be a microprocessor such as Motorola 68000 or Intel 486 chip. The central processor performs all high-level controls such as providing a point-to-point protocol (PPP) or Serial Line Internet Protocol (SLIP) for TCP/IP (Transmission Control Protocol/Internet Protocol) communications, protocols of ITU standards such as H.323 for real-time multi-media communications, and may also conduct encryption/decryption

functions. The appliance uses the random access memory 60 and 60' to temporarily store operation code and data during operation. The network interface module 52 and 52' may be a stand-alone chip, chipsets, and/or other means that provide communication between the local communication medium 36 such as but not limited to POTS, ISDN, wireless such as satellite or cellular, or cable television networks. A POTS modem may be implemented using a commercially available modem chipset such as those produced by Rockwell which are prevalent in the market. For cable Internet access, a cable modem by Motorola and an Ethernet interface chipset can be used as the network interface module. These network interface modules may be designed to be modular such as using the PCMCIA standard so that the appliance can be easily modified for interfacing to the desired choice of network access.

A read only memory (ROM) chip 62 and 62', such as programmable erasable read only memory (EPROM) chip or Flash ROM chip, contains high-level control computer program code to manage all the other devices and deal with network protocols and standards. Flash ROMs provide the added benefit for automatic field upgradability for quick and easy software updates and patches which can be easily performed by the user. Such control code is described in more detail below by the flowcharts describing the appliance operation. The memory chip 62 and 62' may also be programmed to contain a unique network address, a phone number of a local network access provider, memory cache to store information such as recipients' network addresses and telephone numbers, long-distance calling codes that are currently serviced by network service providers for communication with such an appliance, and networking information such as gateway and authentication information. These user setups will be discussed in detail.

Audio compression and decompression may be provided by the central processor 58 and 58' or by dedicated audio/video compressors/decompressors 56 and 56' such as the TrueSpeech CT8020 Digital Signal Processor (DSP) chip available from DSP Group, Inc. of California or by general purpose DSP chips such as Analog Devices' AD21xx family of DSP chips or Texas Instruments' TMS320 family of DSP chips that can be programmed with audio or video compressors and decompressors (codecs) licensed or sold by numerous vendors, such as Lucent Technologies, Intel, and DSP Group. Audio codecs can comply to the following International Telecommunications Union (ITU) standard such as G.711, G.722, G.728, G.723, G.723.1, and G.729. G.723 and G.723.1 standards are preferred for low bit-rate voice communications on low bandwidth network access medium such as POTS. Video compression and decompression may

comply to the following ITU standard such as H.261 and H.263. H.263 is preferred for low bit-rate video communications on low bandwidth network access media.

Both the audio and video codec standards mentioned support ITU H.32x multimedia communication standards. The use of these ITU standards allow the appliance to be interoperable with other computer systems or software that use the same standards.

The central processor in connection with the network interface module operate to establish a network connection such as TCP/IP through the network access medium. The multimedia communications standard used for network communications can include ITU standards such as H.320, H.323, and H.324.

When the connection is established, incoming packets are processed by the DSP chip as directed by the central processor to convert analog audio signals from the transmitter 78 usually a microphone for voice, a charge coupled display (CCD) camera, or the handset of a conventional phone 76 and output digital audio and/or video information to the network. The DSP chip also converts the digital audio information to an analog signal to be output to the receiver 70 such as a speaker or an LCD or television video display or to the handset of a conventional phone 76. The central processor 58 and 58' and the DSP chip can produce packets abiding by a specific communication and network protocols to be transferred via the network interface module 52 and 52' and the local network access medium 36 to the other party. It is also possible to integrate the voice compression & decompression, the high-level central processing functions, and modem functions controlled by a single DSP chip applications specific integrated circuit (ASIC) chip eliminating the need for dedicated chips.

The central database (CDB) 46 will now be described in more detail in connection with Fig. 3. This database is directly connected to a packet-switched network with a static network address as a place of information reference to allow lookup of appliance users or compatible system users as part of the call connection process. A dedicated CDB comprises of a server 80, such as a Digital Alpha server and a fast database 82, such as those commercially-available from Oracle Corporation. The dedicated database also should include a router 84, such as those available from Cisco Systems or Bay Networks, which connects to the network using a high-speed access medium such as a T1 or T3 line connection to network backbones. Duplicates 80' and 82' of the server and database located physically in a geographically different location provides for redundancy for fast access or in case one system becomes inoperative. Databases also may reside at any available network service provider.

The information stored in both the primary and redundant databases are synchronized at regular intervals using standard coherency techniques to maintain the same information. The user information stored in the database includes a unique identifier such as the user's telephone number. The slot for this value in the database is generally permanent for all users of appliances or a compatible appliance or system that is allowed to use this communication system. The value may be modified for example, if a user changes location. The database also includes for each user an identifier which indicates an address for the user when the user's appliance is connected to the packet-switched network. This identifier may be dynamic or fixed, depending on how the addresses are assigned by the network. These network identifiers are used to establish call connection between two or more users. The database may also include other useful or pertinent information for each user such as a subscriber's name, residential address, e-mail address, network service provider's IP address, and billing information.

As the user base increases, the CDBs may be distributed geographically to maximize the efficiency of CDB access and for redundancy. Multiple CDBs can be synchronized to make sure that the databases contain the same information for redundancy. It is also possible to have distinct databases with respective redundant databases for separate groups of users in different locations especially as subscriptions increase. Queries can be processed, for example, by multicasting or broadcasting them to each database.

The following is a scenario of using distinct databases for specific regions. Each database, wherever located world-wide, contains the network addresses of every CDB and the information of every appliance user in that local region. If a new CDB is installed, all existing CDBs are updated with the new CDB's IP address. If a caller in one location calls a recipient at a remote location and the recipient's information is unavailable when the caller's appliance contacts the local CDB, the CDB associates the long-distance dialing codes (e.g. country and area code) with the remote CDB's network address to allow the caller's appliance to establish a link with the remote CDB at the recipient's location. The remote CDB may then take over to continue the process of linking the communication channel between the caller and recipient. In instances where some other recipient's information is used which does not provide sufficient locale information such as the recipient's Internet username or domain name, the CDB can multicast or broadcast the recipient's information to all other CDBs in order to identify the locale of the recipient. Once the remote CDB has been identified, it can then take over to continue the process of establishing the communication channel between the caller and the recipient.

The central database responds to queries from dedicated communication facilities (described below), individual appliances, or any otherwise compatible system that complies to a database query protocol. The response includes packets of stored user data when a match is found. The database permits users with dynamically assigned network addresses to be located. Additionally, this database allows one person to request a connection with another person who is not presently connected to the network. The database also can identify a phone number that allows the network service provider of the individual to make an outgoing phone call from the network to the local individual.

Referring now to Fig. 4, each network service provider supporting this voice communication system also should include functions of a dedicated communication facility (DCF) in order to support a mode of operation where a connection to a recipient appliance is initiated by the service provider. Each DCF may be comprised of a router 90 which may be connected via a high speed access medium (e.g., T1 or T3) to the network, a server 92, remote and network access hardware 94, switch 96 to access the access medium used by the user of appliance, such as a telephone switch, and POTS modem pools 98.

The construction of the system shown in Fig. 4 is very similar to systems used by conventional network service providers. However, most of such network service providers are not programmed to allow outgoing dial-out to subscribers using a network access medium such as POTS, ISDN or Cable. Generally, they are programmed only to respond to incoming telephone calls. However, many systems may have the capability to make such outgoing phone calls. By providing additional functionality to identify an available access line, such capability may be used to initiate a telephone call with a recipient appliance 30. Such capability is useful in the second mode of operation to be described in more detail below.

A first mode of operation of this system uses a conventional long distance call via PSTN for initiating a connection between the recipient and its network service provider. The process of establishing a communication channel between two appliances using this mode of operation will now be described in connection with Fig. 5a using the Internet as an example. First, the caller dials the recipient's telephone number into the appliance using a conventional telephone connected to the appliance or directly into an appliance that is integrated with a conventional telephone in step 100. The appliance then determines, in step 101, whether the telephone call is long distance. If the telephone call is not a long distance call, the appliance allows for a conventional local telephone call over a plain old telephone system (POTS), in step 102. For

example, in the U.S., if the call is determined to be a long distance call from the standard telephone number prefix such as a "1" for inter-state or intra-state long-distance call or "011 + country code" for international long-distance call, the caller's appliance then checks its internal phonebook to see if the recipient's number is present (step 103) as described in detail with Fig. 8. If the recipient's number is found in the phonebook, the calling process continues to step 104. The appliance establishes in step 104 a connection with the recipient's appliance by a conventional circuit-switched network call. If the call is not answered, as determined in step 105, and if no retry is to be performed (step 106), the user may hang up (step 108) by placing the phone handset on-hook. If the call is answered, the caller informs the recipient that a call with this appliance is being made. For example, the caller may request that the recipient press a key on the telephone handset, such as the "*" key or pressing a button the appliance. If the recipient cannot be connected via the appliance for any reason (step 112), a conventional toll call may be continued (step 114) and eventually terminated (step 116); the phonebook check of step 103 helps to minimize this occurrence but it is conceivable that the recipient's appliance could be malfunctioning or has been disconnected. If the recipient has a properly functioning appliance, both appliances hang up (in step 118) and both parties' appliances automatically connect with their network service providers, as described in more detail below in connection with Fig. 8. They may obtain an IP address (steps 120 and 122) dynamically or may already have a static IP address assigned by their network service provider.

With an IP address, each party's appliance then contacts a centralized database to exchange the network addresses to each party (steps 124 and 126) referencing each party's unique identifier such as their respective telephone numbers, as described in more detail below in connection with Fig. 10. In particular, the central database is updated with the recipient's IP address in step 124 and the central database is updated with the caller's IP address in step 126. The caller then queries the central database to receive the recipient's IP address in step 128, as described in more detail below in connection with Fig. 12. If the address is not found, as determined in step 130, the caller's appliance continuously tries to identify the recipient's IP address as indicated by 130 in the loop back to step 128. If one minute or other time limit, has passed, the attempts to access an IP address are terminated and the caller is informed in step 134. The telephone call then may be terminated. If the IP address is found, the caller may establish contact and make a TCP connection with the recipient as indicated at step 136. Also, if the recipient is using the telephone line for general Internet access and the recipient's computer

system has a software that is compatible with the appliance running, a connection also may be attempted. If the connection is not obtained as determined in step 138, and if a retry operation is not to be performed as determined in step 140, the caller may be informed of the lack of connection in step 142 and the phone hangs up in step 144. For example, if the recipient is using a telephone line and receives a busy signal or is already on the phone with an Internet call in progress, the recipient's DCF will send a packet to the caller's appliance of the busy signal. However, upon establishing network access and a connection, the two parties may begin talking as indicated in step 146. When the call is terminated by either party by placing the handset on-hook, the TCP/IP connection is terminated in step 148 and the appliance hangs up in step 150.

One benefit to the first mode of operation is that it uses the existing services available from most POTS network service providers without modifying their software or hardware. Another benefit to this mode is that the caller may call from any compatible communication system rather than an appliance if the caller somehow knows that the recipient has this appliance or the caller' appliance is provided with the protocol to contact the central database and conduct outgoing PSTN toll calls to the recipient.

There are a couple of minor drawbacks with this first mode of operation. First, there could be delays possibly from one-half to around five minutes depending on distance and network traffic conditions to establish a connection. Second, every time a long-distance call is initiated, the caller may incur charges for this initial connection making frequent calls somewhat costly and reducing the freedom to call as frequently as desired. In order to minimize costs for these initial toll-calls, third-party conventional long-distance service providers may be used to allow the caller to be charged on a fraction of a second segments (e.g. one-sixth of a minute) rather than for a full minute.

A second mode of distributed operation is similar to the first mode which requires an initiating conventional long-distance call, however, the toll charge can be eliminated using a local caller identification (Caller ID) service as shown in Fig. 5b. The caller dials the recipient's number using the telephone handset in step 430. The appliance will determine if the call is local or long-distance by counting the digits and checking the calling area code. If the call is long-distance, the caller's appliance automatically looks up the internal phonebook in step 432 to check if the telephone number is associated with an appliance user. If the telephone number is determined to be associated with an appliance user, the caller's appliance will request if an Internet call is desired. The caller's appliance may be set-up to automatically select the Internet

call mode if the number dialed checks with the internal phonebook. If an Internet call is not desired, the appliance will just continue with PSTN toll call (step 436). If an Internet call is desired, the caller's appliance will dial the number and will make sure to allow for a maximum of only two or three rings (usually two) to let the recipient's appliance identify the caller's telephone number (step 440). If the recipient has not yet picked up the phone and the appliance detects that the caller is an appliance user by checking its internal phonebook in step 442, the recipient's appliance will wait until the ringing stops in step 446. If the recipient picks up the phone before the appliance has had a chance to identify the caller, the operation reverts back to the first mode. If the caller is identified not to be an appliance user as determined by the internal phone book, then the recipient's appliance will let the call process as a conventional one (step 444) and let the phone ring. After waiting for two or three rings, the caller's appliance will then automatically hang up in step 448 and continue with the rest of the first mode of operation beginning with step 122'. If the recipient has not yet picked up the phone and the caller has been identified as an appliance user by the recipient's appliance, the recipient's appliance will then continue to establish an Internet connection with steps 120' and 124'. While the appliance attempts to establish an Internet call connection and the recipient picks up the phone, the appliance will so inform the recipient that an Internet call is in progress with the caller identified on, for example, an LCD display. The recipient will have control to cancel an Internet call in progress if so desired by pressing a button on the appliance or a button on the handset such as the "*" or "#."

Benefits to the second mode of operation is that it uses the existing services available from most POTS network service providers without modifying their software or hardware just like the first mode of operation. Another same benefit to this mode is that the caller may call from any compatible communication system rather than an appliance if the caller somehow knows that the recipient has this appliance or the caller' appliance is provided with the protocol to contact the central database and conduct outgoing PSTN toll calls to the recipient. However, one major disadvantage of the caller being charged for the initial PSTN toll call associated with the first mode of operation is reduced or eliminated. The second mode of operation also eliminates the need for the recipient to intervene by picking up the handset and pressing a button to initiate an Internet call as in the first mode of operation. The second mode of operation increases the ease of establishing an Internet call and also helps to reduce PSTN long-distance charges even further.

A third mode of distributed operation is used when network service providers have the ability to call out to the recipient via its network access medium, with similar capabilities of a DCF, for example, as shown in Fig. 4. This mode of operation will now be described in connection with Fig. 6. With this embodiment, the appliance is configured with a local DCF telephone number, however assigned, or other mechanism to access the network. The customer information including at least the subscriber's telephone number and DCF's network address may then be transferred to the central database (CDB) of subscribers and/or maintained on a DCF database.

The flow of information in the third mode of operation will first be described using the Internet protocol as an example. When a caller attempts to make a long-distance call, the appliance automatically accesses a local DCF or an NSP (since an outgoing call to the caller is unnecessary) by means of the local network access medium to gain network access to the packet-switched network via for example a standard PPP/SLIP and authentication. When connection to the DCF/NSP is established, the caller's appliance sends a query packet (described below) containing the recipient's telephone number or other distinct identification information such as a residential address, IP address, electronic mail address, to initiate a long-distance call.

Upon determining at least the recipient's DCF network address, the caller's appliance, caller's DCF/NSP, or the CDB contacts the recipient's DCF to transmit an information packet (described below) that contains the recipient's local telephone number or other information such as the caller's network address. To minimize delays, one method is to have the CDB directly send the recipient's telephone number and caller's network address directly to the recipient's DCF. However, selected information, its point of origin and its transfer method may vary among different implementations.

With the recipient's local telephone number, the recipient's DCF then makes an outgoing call to authenticate and to establish network access via PPP/SLIP if using POTS with the recipient's appliance. Authentication may be made by the DCF prior to making the outgoing call if the recipient's information received is sufficient for such pre-authentication in order to minimize delays.

The following will describe a few methods of initiating a communication channel through a packet-switched network. In one method, if the recipient answers the call and the recipient's appliance is provided with the caller's network address by a CDB or its DCF, the recipient's appliance may directly contact the caller's appliance with the caller's network address to initiate

a communication channel. In another method, the recipient's appliance or DCF sends an information packet containing the recipient's network address to the caller's appliance upon which the caller's appliance initiates the communications channel using the recipient's network address. Whichever way, a communication link between the caller and the recipient may be established to begin transmitting information packets over the network.

One embodiment of the data flow associated with the third mode of operation will now be described in more detail in connection with the flow chart of Fig. 6a. In particular, the caller dials the recipient's telephone number into the appliance using a conventional telephone connected to the appliance or directly into the appliance integrated with a conventional telephone in step 200. The appliance then determines whether the telephone call is long distance, as determined in step 202. If the telephone call is not a long distance call, the appliance makes a local telephone call over a plain old telephone system (POTS), in step 204. If the call is determined to be a long distance call, the caller's appliance checks its internal phonebook to see if the recipient's number is present (step 205) as described in detail with Fig. 8. If the recipient's number is found in the phonebook, the calling process continues to step 206. The caller's appliance automatically dials a local network service provider (NSP) or DCF to establish a PPP/SLIP link (step 206), as described in more detail below in connection with Fig. 9. If a PPP/SLIP link is not established as determined in step 208, a retry may be performed in steps 210 and 206 or the appliance or caller may hang up in step 212. If a PPP/SLIP link is established, the caller's appliance sends a packet with the recipient's access information to the local central database (step 214) and queries the central database for the IP address of the recipient's dedicated communication facility step 216. This step is described in more detail below in connection with Fig. 12. If the IP address of the recipient's dedicated communication facility is not found, as determined in step 218, the caller may be given an option to make a conventional toll call in step 220. If no toll call is to be made, the appliance or caller hangs up in step 222. Otherwise, a toll call may be made through a conventional public switched telephone network in step 224. When the call is completed, the caller hangs up in step 226.

If the caller connects to the network and identifies the IP address of the recipient's dedicated communication facility, the appliance then sends a packet with a caller's IP address and the recipient's access information, e.g., its telephone number, to the recipient's dedicated communication facility in step 228. This information allows the recipient's DCF to connect with the recipient's appliance over the recipient's network access medium, for example, by making a

telephone call, to establish a point-to-point protocol link in step 230. During this process, the caller may be informed of the call status with phone ringing sounds on the recipient's telephone. This process is described in more detail below in connection with Fig. 11. If a link is established, the recipient's DCF sends a packet with a recipient's appliance IP address to the caller's appliance in step 232. The caller's appliance then connects to the recipient's appliance via a TCP/IP connection in step 236. Also, if the recipient is using the telephone line for Internet access and the recipient's computer system has a software that is compatible with the appliance running, a connection also may be attempted. If a connection is not achieved as determine in step 238, a retry operation may be performed in steps 240 and 236. Otherwise, the caller may be informed that no connection is established in step 242 and the appliance hangs up in step 244. For example, if the recipient is using a telephone line and receives a busy signal or is already on the phone with an Internet call in progress, the recipient's DCF sends a packet to the caller's appliance of the busy signal. If a TCP/IP connection is made, the two parties may begin talking as indicated in step 246. When the call is terminated, the TCP/IP connection is terminated in step 248 and the parties may hang up as indicated at 244.

A benefit of the third mode of operation is that initial long distance toll calls over the public switched telephone network for establishing an network connection between the caller and the recipient are completely eliminated. The delay in making a connection may be reduced in comparison to the first mode as well. This third mode does involve modification to network service providers to allow the outgoing telephone calls to be made.

The fourth mode of operation is similar to the third mode by using dial-out service providers (DOSP) that could be located at many locations world-wide where there are large concentrations of appliance users rather than depending on network service providers to provide dial-out service. These dial-out service providers would be connected to the Internet and have dial-out capability using modem banks to inform the recipient's appliance of an incoming Internet call. This operation eliminates the need to modify existing network service providers for dial-out capability. Figure 6b shows the operation and will be described.

Steps 500 through 514 is the same as the third mode of operation described previously. If a PPP/SLIP link is established in step 510, the caller's appliance sends a packet with the recipient's access information to the local central database (step 516) and queries the central database for the IP address of the recipient's dial-out service provider in step 518. This step is described in more detail below in connection with Fig. 12. If the IP address of the recipient's

DOSP is not found, as determined in step 518, the caller may be given an option to make a conventional toll call in step 520. If no toll call is to be made, the appliance or caller hangs up in step 524. Otherwise, a toll call may be made through a conventional public switched telephone network in step 522. When the call is completed, the caller hangs up in step 514.

If the caller connects to the network and identifies the IP address of the recipient's DOSP, the caller's appliance then sends a packet with the recipient's access information, e.g., its telephone number, to the recipient's DOSP in step 526. This information allows the recipient's DOSP to connect with the recipient's appliance over the recipient's network access medium, for example, by making a telephone call, to establish a point-to-point protocol link in step 528. During this process, the caller may be informed of the call status with phone ringing sounds on the recipient's telephone. This process is described in more detail below in connection with Fig. 11. If a link is established, the DOSP requests the recipient to indicate acceptance of the network phone call by, for example, pressing the "*" button on the handset in step 530. Steps 530 through 566 is essentially the same as that of the first and second modes of operation shown in Fig. 5a from steps 110 through 144.

A benefit of the fourth mode of operation is that initial long distance toll calls over the public switched telephone network for establishing an network connection between the caller and the recipient are completely eliminated. Another benefit of the fourth mode is that it does not involve modification to network service providers but rather uses less expensive (compared to network service providers) dedicated dial-out service providers to allow the outgoing telephone calls to be made to the recipient. However, the delay in making a connection may be twice as long in comparison to the first mode.

The fifth mode of operation will now be described with reference to Fig. 7. If continuous network access such as cable Internet access is used by the caller, a continuous network link is provided so that there will not be a need to dial into the service provider nor conduct authentication. If the recipient has such continuous Internet access, the caller automatically dials the recipient via packet-switched means without the need for conducting a short long-distance call as associated with the first mode of operation; the caller could have accessed the Internet via any means. This is similar to the third mode of operation described above using POTS Internet access however, using a continuous Internet access such as cable does not require any modifications to the cable service provider. This operation mode is also much faster for connection than the first, second, or third mode of operation.

An example of using the appliance with a continuous cable television Internet access will be described. The appliance may be equipped with a network interface module comprising an Ethernet interface card connected to a cable modem such as those manufactured by Motorola. The appliance may be connected to both the cable Internet access line and the local exchange carrier. The unique MAC address that comes with each Ethernet interface card is registered with the cable Internet access provider for authentication. If static IP address is not assigned, the cable Internet access provider will automatically assign a dynamic IP address to the user whenever a connection is established using the Ethernet interface card's unique MAC address. If dynamic IP addressing is used, the appliance updates the central database upon obtaining a new IP address.

Fig. 7 shows an example of a task flow for establishing a connection using a continuous Internet link. Caller dials the recipient's number (step 450) and the appliance determines if the call is a long-distance call in step 452. If it is not a long-distance call, a local POTS call may be made. Otherwise, the caller's appliance may check the phonebook (step 455) as an option and if the recipient's telephone number is found, it sends a packet with the recipient's phone number to the central database (CDB) in step 456. Regardless of whether the phonebook function is used or not used, a CDB query is made (step 458) with the recipient's phone number and if the recipient's IP address is found (step 460) the caller's appliance attempts to establish a connection with the recipient's appliance in step 470. If the recipient's IP address is not found, then the caller is notified to decide on making a conventional toll call in step 462. After a conventional toll call is made in step 464, the caller then hangs up (step 466). If a conventional call is not made, the caller simply hangs up (step 468). If the recipient's IP address is found, the caller's appliance attempts to connect in step 472. If a connection is not made, the caller's appliance attempts to retry in step 474. If after several retries the connection could not be established, the caller is informed (step 480) and the caller hangs up in step 482. If a connection is made, the call is initiated in step 476 via TCP. Upon call completion, the TCP connection is closed with the recipient's appliance (step 478) and the call is terminated in step 482. The continuous connection to the network such as those with cable Internet access provider simplifies and speeds up the network call connection process.

Fig. 8 describes in more detail how a caller's appliance or compatible system checks and updates the phonebook of a recipient such as performed in step 101 of Fig. 5a and step 205 of Fig. 6a. The process of looking up a phone book eliminates the requirement of establishing a

long-distance call and incurring toll charges to determine if a recipient is capable of receiving a network call via the Internet and also provides the caller an option to cancel the call without establishing a toll connection with the recipient. If the recipient's phone number is found in its internal phonebook, the processes in Fig. 5 or Fig. 6 continue. However, if the recipient's phone number is not found, the caller is informed of this status (step 404) and requests the caller to decide if the appliance or compatible system should check if the recipient is a subscriber (step 406). If the caller decides not to conduct the check, the caller is given the option to continue with a PSTN toll call (step 408). If the caller decides not to continue with a toll call, the appliance hangs-up (step 414). Otherwise, a conventional long-distance call is made (step 410) and upon call completion, the appliance hangs-up. If the caller decides to check if a recipient is a subscriber, the caller's appliance dials into the local network service provider to establish a PPP/SLIP link (step 416). Upon establishing the PPP/SLIP link, the caller's appliance queries a central database server with the recipient's telephone number to check the status of the recipient's subscriber status (step 418). If the recipient is determined to be not a subscriber, i.e., not in the database at the decision step 420, then the procedure for a request to continue with a PSTN toll call (steps 408-414) is carried out. Otherwise, the central database sends a confirmation packet to the caller's appliance with the telephone number and any other pertinent information (step 422). The caller's appliance automatically updates the phonebook with the recipient's information (step 424) and the caller is informed of the update (step 426). Upon completion the subsequent steps are then continued. The appliance's user interface will allow any telephone number in the phonebook to be added, deleted, or edited.

How the appliance dials into a network service provider or dedicated communication facility to establish PPP/SLIP link will now be described in more detail in connection with Fig. 9. This example assumes that the network service providers are accessed using a regular telephone line (i.e. POTS). It is possible to make such a connection via a cable television modem or by connection through electrical power lines, among other mechanisms. In this embodiment, the appliance makes a regular telephone call to a network service provider to make a connection as indicated at step 250. If a connection is not made, as determined in step 252, the appliance may retry this operation as indicated at 254 and 250. Otherwise, the caller may be informed that connection was not made in step 256 and the appliance hangs up in step 258. If a connection to the network service provider is made, authentication information is sent to the provider in step 260. If authentication is not achieved, as determined in step 262, a retry of the

authentication operation may be performed as indicated at 264 and 260. Otherwise, the caller may be informed that authentication was not achieved in step 266 and the appliance hangs up in step 268. If authentication is achieved, a PPP/SLIP link may be established in step 270. Successful establishment of this link, as determined in step 272 results in the appliance being successfully connected to the network. Otherwise, a retry operation may need to performed in step 274 and 250.

Referring now to Fig. 10, the process of updating the central database with a network address will now be described in more detail. Each appliance has a CDB network address already encoded. If the appliance happens to have a CDB network address not in its locale, during initial setup when the user inputs the telephone number and other calling codes, the remote CDB automatically assigns an network address of a CDB in the appliance's locale and updates the appliance with the new CDB network address. Using a local CDB should help decrease connection time for calling. It also may help increase the connection speed for someone who wants to call the appliance because the recipient's local CDB may be directly contacted rather than by multicasting or broadcasting.

The CDB updating process involves sending information which comprise of the current network address and any other correlating unique information such as a telephone number for updating to the central database server in step 280. This information is sent in a packet, of which example formats will be described in more detail below in connection with Figs. 13 and 14. The appliance then awaits for a reply from the central database in step 282. If a reply does not indicate that data has been successfully updated, as determined in step 284, an attempt to update the information is retried in step 280. It may be desirable to put a time out operation in this loop, as indicated at 283. If a time out occurs, the caller is informed and may hang up as indicated at 285.

Referring now to Fig. 12, the logic flow of the central database will now be described in more detail. In particular, the central database server receives a request in step 290 that indicates the recipient's telephone number or other means for access that provides a unique identification of how the recipient connects to the network. This may be, for example, a telephone number. The database is then searched by the server for the recipient's unique identification information in step 292. If it is not found, a "not found" packet is then sent in step 294. If the information is found, the recipient's data, such as the network address of the dedicated communication facility used by the recipient and its personal network address and any other pertinent information, are

packaged in a packet which is then sent to the caller's appliance in step 298.

The CDB request may be substituted by broadcasting and multicasting for any mode of operation. In such an embodiment, the caller's appliance processes the information packet and broadcast/multicast it to the world-wide Internet or other "white-page" services such as the "People Find" service from Lycos, or the "Big Yellow" Internet business yellow pages to obtain the recipient's individual information. The CDB or the recipient's DCF answers with at least the DCF network address when a matching recipient is found. After establishing contact with the CDB or recipient's DCF, the caller's appliance has the option to store and maintain the recipient's information in a local cache, i.e., phonebook for future use to minimize continual connections with CDB in an effort to reduce delays in establishing contact with the recipient for subsequent phone calls. If the recipient's or recipient's DCF network address is unavailable, the caller's appliance is informed and may be provided with an option to make a conventional long-distance phone call or automatically switch to the first mode of operation if the recipient was determined to be a subscriber as described above.

Example packet types which may be used by the system are shown in Figs. 13 and 14. These packets are transmission control protocol (TCP) packets that communicate over dedicated ports. The TCP packet shown in Fig. 13 includes a first byte of data indicating a type which may include a central database query, phone query, dedicated communication facility update, phone update, additions and deletions, or message indicating the party is ready to talk. The next four bytes of data indicate a length which represents the length of the data field 304 which follows. The data portion of the packet may contain one or more type, length and value entities, such as shown in Fig. 14. The type field 306 indicates a type such as whether the data includes a phone number. The length field 308 indicates the length of the value field 310. By using such packets, each of the central database, dedicated communication facility and the appliance readily may identify information which it needs to process, and how that information should be processed.

How a recipient's dedicated communication facility dials a recipient's appliance to establish a PPP/SLIP link, such as performed in step 230 of Fig. 6, will now be described in more detail in connection with Fig. 11. This operation is performed in manner similar to how a computer generally contacts a network server provider via a modem. In particular, the dedicated communication facility dials out to the recipient via the plain old telephone system (POTS) or other access media used by the appliance, in step 320. After step 320, if the caller hangs up

during the outgoing call step 328, the caller's appliance will inform the recipient's DCF to cancel the call before disconnecting from TCP/IP connection in step 330. In step 322, upon being informed of the caller appliance's on-hook status, the recipient's DCF cancels the outgoing call to the recipient. If the call is answered in step 322, authentication is performed in step 323. If authentication is not achieved, the appliance hangs up in step 328. If authentication is achieved, then an IP address is set in 324 and a PPP/SLIP link is established in 326. If the call is not answered, the dedicated communication facility hangs up in step 328 and informs the caller.

A user interface also may be provided for call status notification and setting up the appliance for initial and continual use. The user may be presented with menu items or call status such as by visual means with a liquid crystal display, audible means with voice messages to the speaker, or a combination thereof. The user may interact with the appliance via one or more means such as with a numeric keypad found on a conventional phone attached to the appliance, pushbuttons, dials, or by voice commands to the handset that may be recognized by the appliance.

A set of main menu items for the appliance may include (a) phonebook, (b) Internet access setup, (c) dialing setup, and (d) auto upgrade. When the phone book menu item is selected, phone numbers may be displayed and scrolled using an electro-mechanical thumb-dial interface attached to a potentiometer. Push buttons for deleting and editing a telephone number may be provided. New telephone numbers might be added, edited, or deleted manually using the numeric dialing keypad on the conventional telephone connected to the appliance. The Internet access setup if using POTS might include an Internet service provider's telephone number, username, and password. ASCII or foreign characters may be entered into the appliance by, for example, using the same thumb-nail dial described previously to select a character, the numeric dialing keypad on the conventional telephone attached to the appliance, or a dedicated keypad. The dialing setup might include the user's telephone number with area code and country code, call waiting cancel, and other dial-out prefixes. The auto upgrade menu item, which may be used with Flash ROM for field upgradability, may be executed with a single command from the user. Upon receiving the user command, the appliance automatically upgrades the appliance's software by auto-dialing into the network service provider, establishing a networking link such as PPP and TCP/IP, contacting a pre-programmed network address supporting a software download, uploading to the network address the model and version of the appliance, receiving the updated software or patches, hanging up, and executing the downloaded software in the

appliance.

By using the mechanisms described above, a caller's appliance ensures that a connection is made between the packet-switched network and the recipient of a telephone call. At least three modes of operation may be used in order to ensure that this connection is made. Additionally, with these appliances the network service providers of the caller and recipient do not require dedicated ports for voice communication. Accordingly, the cost of long distance calls may be reduced without substantially increasing the cost of maintenance of specialized voice communication hardware on the part of the network access providers. By providing a dedicated appliance such telephony is not limited to computer users and owners. With these features this telephony appliance may be used in the same manner as a conventional telephone.

Having now described a few embodiments of the invention, it should be apparent to those skilled in the art that the foregoing is merely illustrative and not limiting, having been presented by way of example and practice. Numerous modifications and other embodiments are within the scope of one of ordinary skill in the art.

For example, other communication protocols over a packet-switched network may be used such as TCP/IP, Frame Relay, ISDN, and IPX providing for reliable transmission or User Datagram Protocol (UDP) that uses Real-Time Protocol (RTP) to handle streaming audio and video and which is a part of the ITU H.323 standard for unreliable transmission. Wireless and asynchronous transfer mode (ATM) networks operating using packet or cell switching also may be used.

Additional functionality also may be provided, such as video and wireless capabilities. An example of video and wireless capability might include a mobile appliance that functions in a vehicle such as an automobile where the outgoing packet-switched communications signals such as video signals are sent by processing video images of the sender using a charge-coupled display (CCD) area sensors such as those sold by Sony Corporation and audio signals are sent by processing voice or audio from the sender using a microphone with active acoustical error cancellation circuitry for full-duplex hands-free speakerphone operation. The incoming packet-switched communication signals are also processed and delivered to the recipient via same wireless means. The incoming processed audio may be transmitted, for example, through the automobile's speakers via radio frequency (RF) signals sent directly to a radio's antenna inside the vehicle. The incoming processed video may be transmitted via a high-resolution liquid crystal display (LCD) such as those sold by Fujitsu or a miniature cathode ray tube (CRT) such

as those found on small television sets for which the image of the recipient can be seen directly from a visual display or viewed, for example, reflected off the front windshield of an automobile so that the driver quickly can focus in and out of the visual image while driving.

Flowing fax transmissions to conventional fax machines or storing fax transmissions also may be added by using standard fax and reliable network transmission protocols. Capability commonly found in conventional telephones also may be added, such as number memory, a mute button, a redial button, speed dial, alphanumeric keypad, answering service, caller identification, call-waiting option, calling capability without using telephone number, caller identification memory, teleconferencing, full duplex speaker phone, cordless handset, voice mail, etc. These functions may be integrated using telephony application programming interfaces (TAPI) developed by Microsoft and Intel for computer telephony application development such as those for PBX systems.

An appliance also may be constructed so as to accommodate different telephony standards such as telephone jacks and various POTS transmission laws such as A-law and Mu-law.

These and other modifications are contemplated as falling within the scope of the invention as defined by the appended claims and equivalents thereto.

CLAIMS

1. A communication system for communication using a packet switched network, comprising:

a first network access system for providing access to the packet switched network;

a second network access system for providing access to the packet switched network;

a first appliance having means for connecting to the first network access system through a first access medium, and means for sending and receiving packets through the means for connecting to the packet switched network;

a second user appliance having means for connecting to the second network access system through a second access medium, wherein the second appliance includes means for causing the first appliance to connect to the packet switched network through the first network access system using the means for connecting to the first network access system, and means for sending and receiving packets to and from the first appliance through the means for connecting and the packet switched network.

2. The communication system of claim 1, wherein the means for causing the first appliance to connect to the packet switched network in the second appliance comprises:

means for connecting with the first appliance using a public switched telephone network; and

means for instructing the first appliance to connect to the first network access system using the means for connecting of the first appliance.

3. The communication system of claim 1, wherein the means for causing the first appliance to connect to the packet switched network in the second appliance comprises:

means for identifying the first network access system; and

means for instructing the first network access system to connect with the first appliance through the means for connecting in the first appliance.

4. The communication system of claim 1, further comprising:

a central database of user information including, for each of the first and second appliances, a first unique identifier indicating an address for the appliance accessible using the packet switched network and a second unique identifier indicating an access mechanism for establishing a connection over an access medium between the first and second network access systems and the first and second appliances, and comprising means, operative in response to a query, for returning one of the first and

second unique identifiers.

5. An appliance for communication using a packet switched network,

means for connecting the appliance to a first access medium;

means for connecting to a first network access system connected to the packet switched network using the access medium;

means for causing another appliance to be connected through a second access medium to a second network access system connected to the packet switched network; and

means for sending communication packets through the packet switched network to the other appliance after connection of the other appliance to the packet switched network is established.

6. A database system for storing information supporting a communication system using a packet switched network, wherein first and second appliances are connected through first and second access media to first and second network access systems which are connected to the packet switched network, comprising:

means for storing user information including, for each of the first and second appliances, a first unique identifier indicating an address for the appliance accessible using the packet switched network and a second unique identifier indicating an access mechanism for establishing a connection over an access medium between the first and second network access systems and the first and second appliances; and

means, operative in response to a query, for returning one of the first and second unique identifiers.

7. The database system of claim 6, further comprising means for adding user information to the database.

8. The database system of claim 6, further comprising means for deleting user information from the database.

9. The database system of claim 6, further comprising means for updating user information in the database.

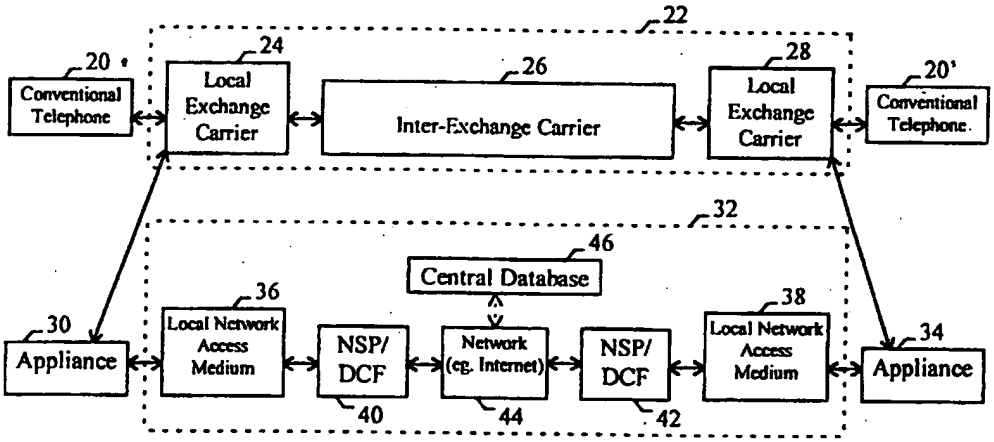
22
20
Conventional Telephone
24
Local Exchange Carrier
26
Inter-Exchange Carrier
28
Local Exchange Carrier
20'
Conventional Telephone
32
46
Central Database
36
Local Network Access Medium
38
Local Network Access Medium
30
Appliance
NSP/ DCF
Network (eg. Internet)
NSP/ DCF
34
Appliance
40
44
42

FIG. 1

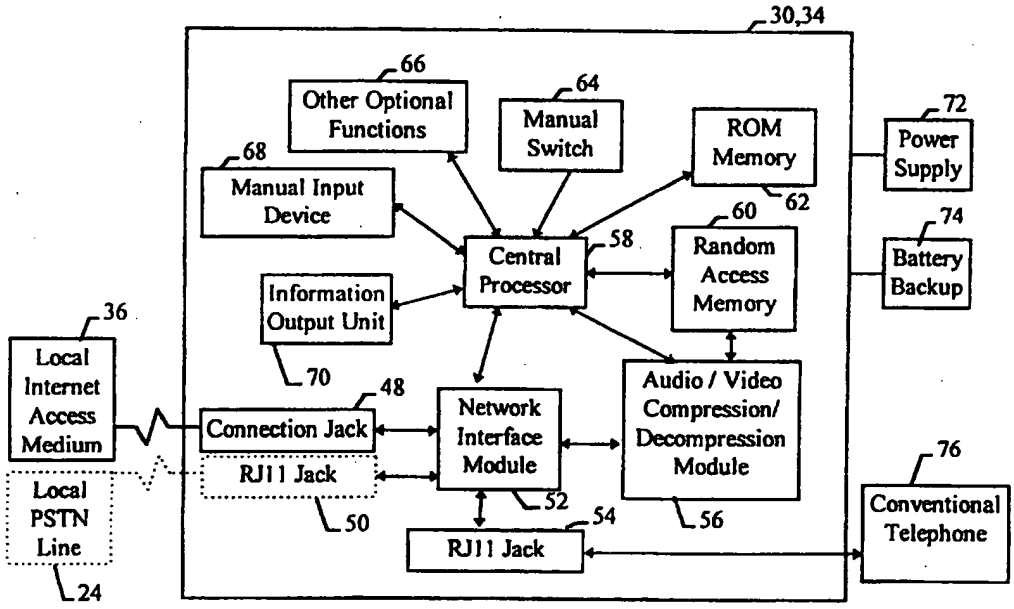
30,34
66
Other Optional Functions
64
Manual Switch
ROM Memory
72
Power Supply
68
Manual Input Device
62
60
74
Battery Backup
58
Central Processor
Random Access Memory
Information Output Unit
36
Local Internet Access Medium
70
48
Connection Jack
Network Interface Module
Audio / Video Compression/ Decompression Module
RJ11 Jack
52
76
Conventional Telephone
50
54
56
RJ11 Jack
Local PSTN Line
24

FIG. 2a

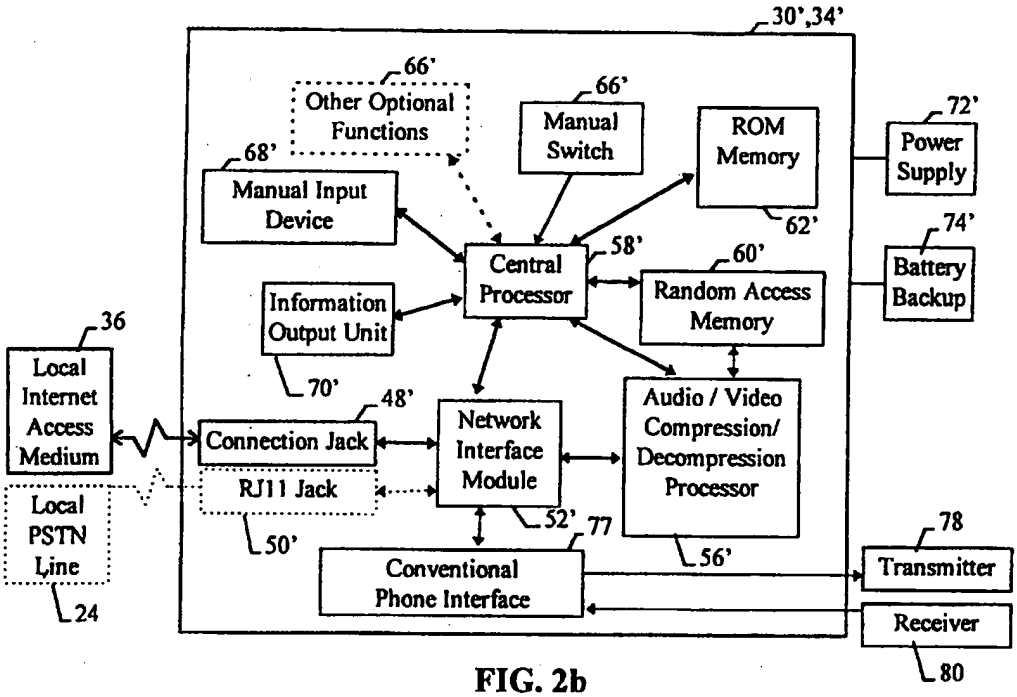
30',34'
66'
Other Optional Functions
66'
Manual Switch
ROM Memory
72'
Power Supply
68'
Manual Input Device
62'
74'
Battery Backup
58'
60'
Central Processor
Random Access Memory
Information Output Unit
70'
36
Local Internet Access Medium
48'
Connection Jack
Network Interface Module
Audio / Video Compression/ Decompression Processor
RJ11 Jack
52'
77
78
Local PSTN Line
50'
56'
Transmitter
Conventional Phone Interface
Receiver
24
80

FIG. 2b

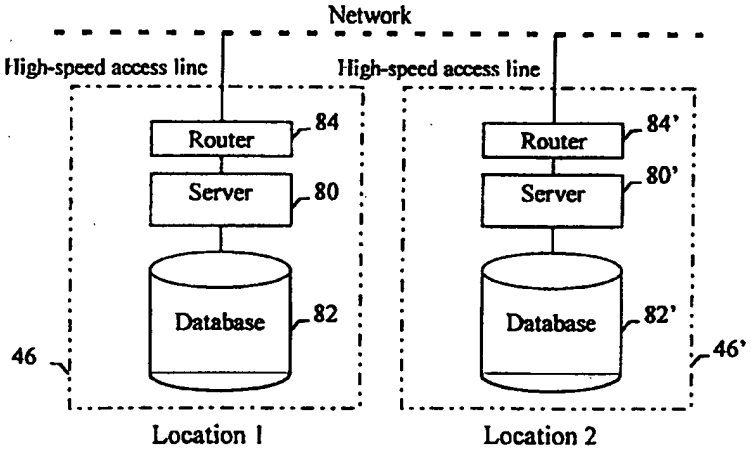
Network
High-speed access line
High-speed access line
Router
84
Router
84'
Server
80
Server
80'
Database
82
Database
82'
46
46'
Location 1
Location 2

FIG. 3

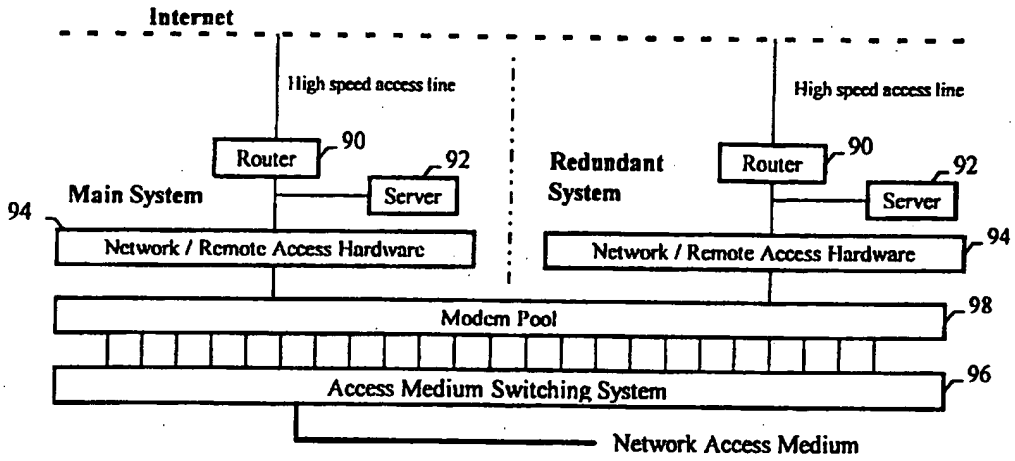
Internet
High speed access line
High speed access line
Router
90
92
Server
Main System
94
Network / Remote Access Hardware
Redundant System
Router
90
92
Server
Network / Remote Access Hardware
94
Modem Pool
98
Access Medium Switching System
96
Network Access Medium

FIG. 4

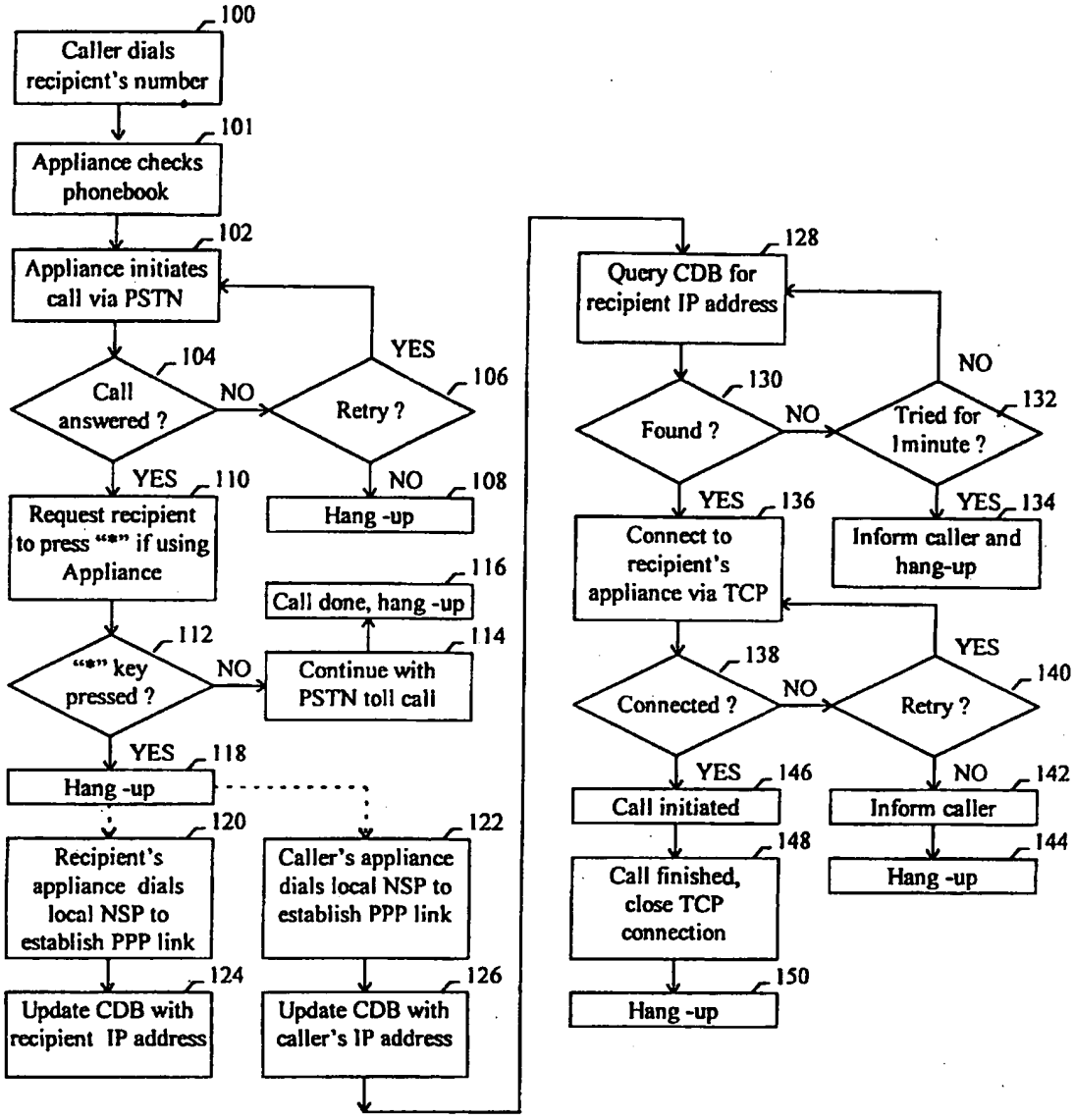
100
Caller dials recipient's number
101
Appliance checks phonebook
102
Appliance initiates call via PSTN
104
Call answered ?
NO
YES
106
Retry ?
YES
NO
108
Hang -up
110
Request recipient to press "*" if using Appliance
112
"*" key pressed ?
NO
114
Continue with PSTN toll call
116
Call done, hang -up
YES
118
Hang -up
120
Recipient's appliance dials local NSP to establish PPP link
122
Caller's appliance dials local NSP to establish PPP link
124
Update CDB with recipient IP address
126
Update CDB with caller's IP address
128
Query CDB for recipient IP address
130
Found ?
NO
132
Tried for 1minute ?
NO
YES
134
Inform caller and hang-up
YES
136
Connect to recipient's appliance via TCP
138
Connected ?
NO
YES
140
Retry ?
NO
142
Inform caller
144
Hang -up
YES
146
Call initiated
148
Call finished, close TCP connection
150
Hang -up

FIG. 5a

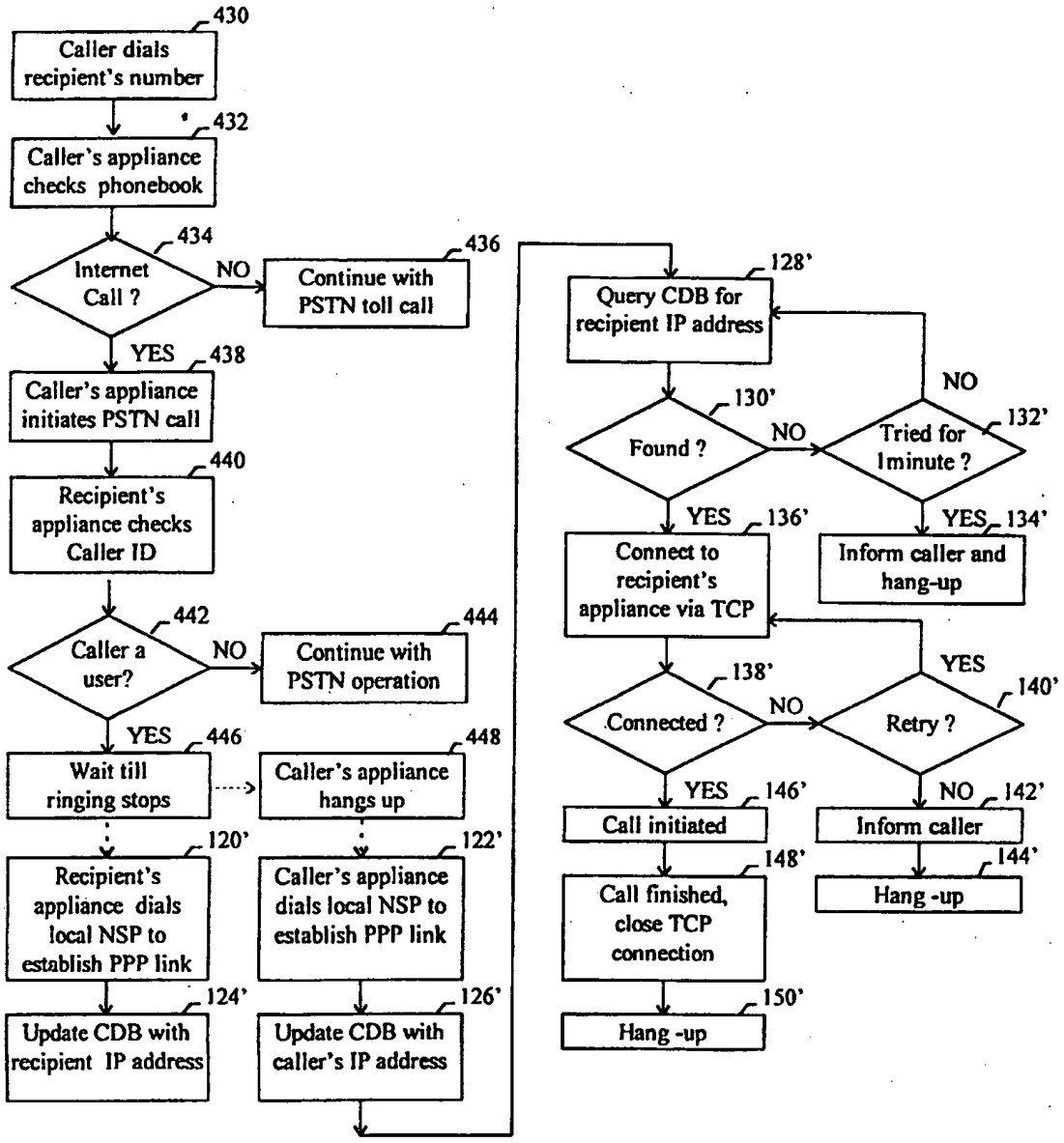
430
Caller dials recipient's number
432
Caller's appliance checks phonebook
434
Internet Call ?
NO
436
Continue with PSTN toll call
YES
438
Caller's appliance initiates PSTN call
440
Recipient's appliance checks Caller ID
442
Caller a user?
NO
444
Continue with PSTN operation
YES
446
Wait till ringing stops
448
Caller's appliance hangs up
120'
Recipient's appliance dials local NSP to establish PPP link
122'
Caller's appliance dials local NSP to establish PPP link
124'
Update CDB with recipient IP address
126'
Update CDB with caller's IP address
128'
Query CDB for recipient IP address
130'
Found ?
NO
132'
Tried for 1minute ?
NO
YES
136'
Connect to recipient's appliance via TCP
YES
134'
Inform caller and hang-up
138'
Connected ?
NO
YES
140'
Retry ?
YES
146'
Call initiated
NO
142'
Inform caller
148'
Call finished, close TCP connection
144'
Hang -up
150'
Hang -up

FIG. 5b

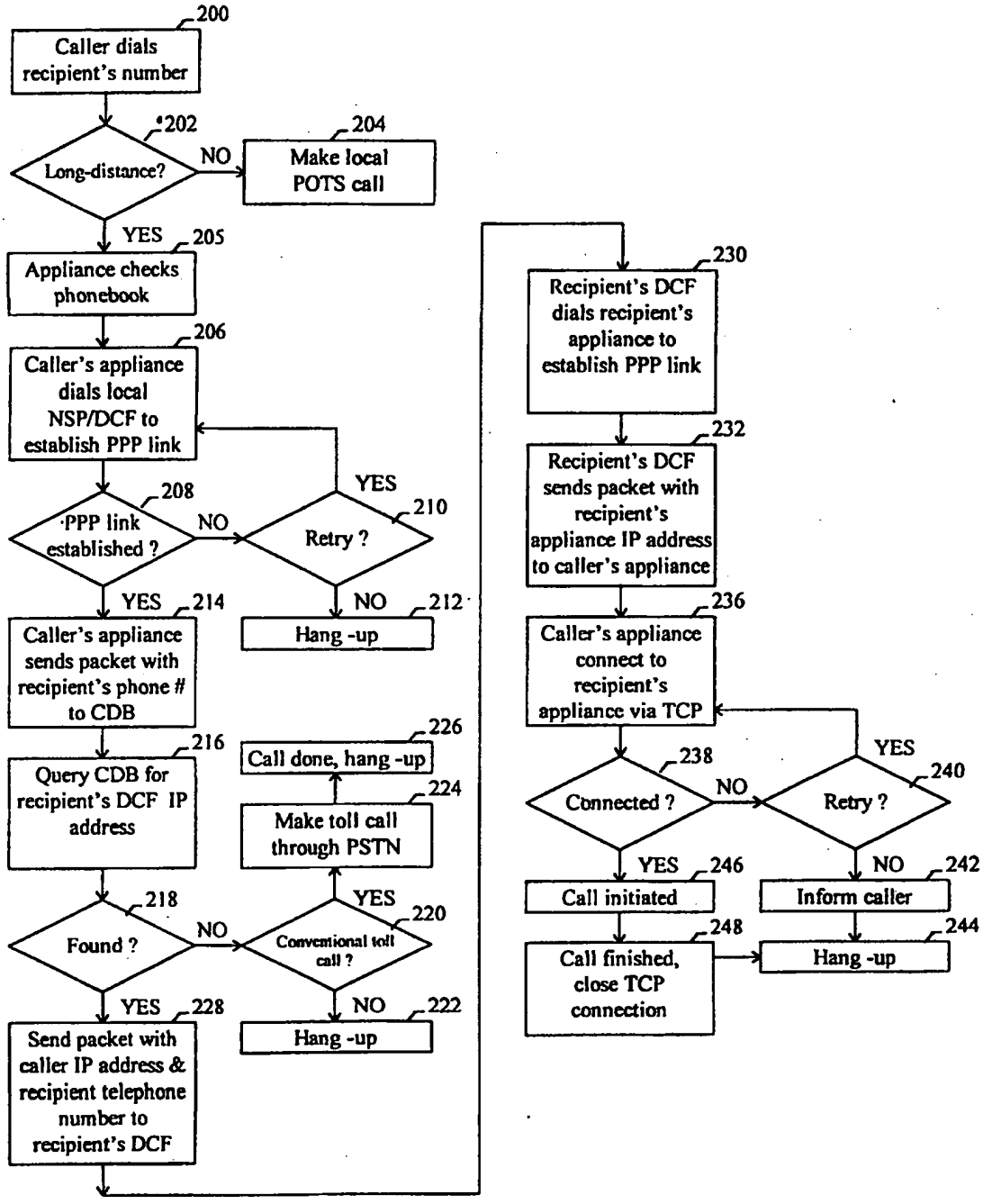
200
Caller dials recipient's number
202
Long-distance?
NO
204
Make local POTS call
YES
205
Appliance checks phonebook
206
Caller's appliance dials local NSP/DCF to establish PPP link
208
PPP link established ?
NO
YES
210
Retry ?
NO
212
Hang -up
YES
214
Caller's appliance sends packet with recipient's phone # to CDB
216
Query CDB for recipient's DCF IP address
218
Found ?
NO
YES
220
Conventional toll call ?
NO
222
Hang -up
YES
224
Make toll call through PSTN
226
Call done, hang -up
YES
228
Send packet with caller IP address & recipient telephone number to recipient's DCF
230
Recipient's DCF dials recipient's appliance to establish PPP link
232
Recipient's DCF sends packet with recipient's appliance IP address to caller's appliance
236
Caller's appliance connect to recipient's appliance via TCP
238
Connected ?
NO
YES
240
Retry ?
YES
246
Call initiated
248
Call finished, close TCP connection
NO
242
Inform caller
244
Hang -up

FIG. 6a

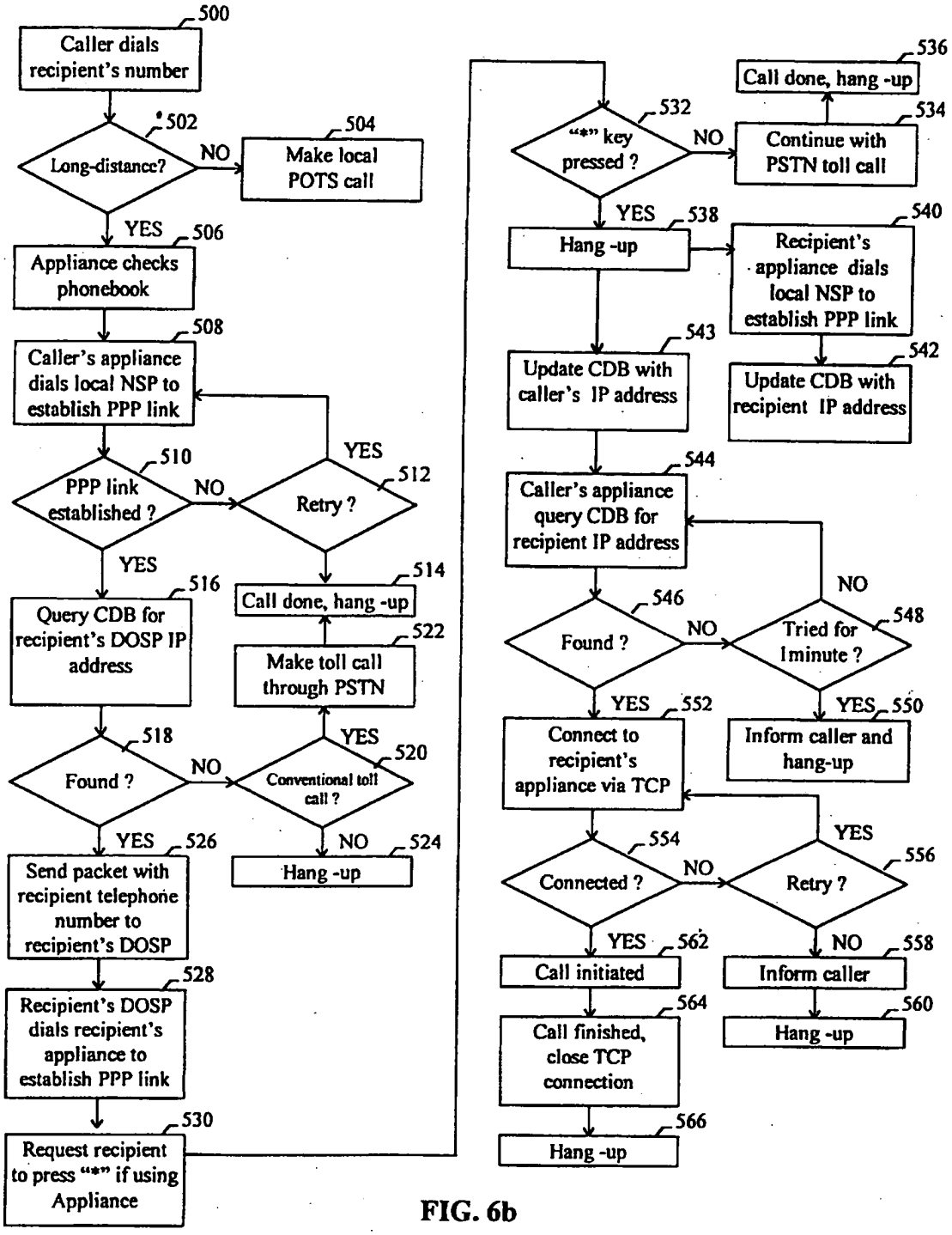
500
Caller dials recipient's number
502
Long-distance?
NO
504
Make local POTS call
YES
506
Appliance checks phonebook
508
Caller's appliance dials local NSP to establish PPP link
510
PPP link established ?
NO
YES
512
Retry ?
YES
514
Call done, hang -up
516
Query CDB for recipient's DOSP IP address
522
Make toll call through PSTN
518
Found ?
NO
YES
520
Conventional toll call ?
YES
NO
524
Hang -up
526
Send packet with recipient telephone number to recipient's DOSP
528
Recipient's DOSP dials recipient's appliance to establish PPP link
530
Request recipient to press "*" if using Appliance
532
"*" key pressed ?
NO
536
Call done, hang -up
534
Continue with PSTN toll call
YES
538
Hang -up
540
Recipient's appliance dials local NSP to establish PPP link
543
Update CDB with caller's IP address
542
Update CDB with recipient IP address
544
Caller's appliance query CDB for recipient IP address
546
Found ?
NO
NO
548
Tried for 1minute ?
YES
552
Connect to recipient's appliance via TCP
YES
550
Inform caller and hang-up
554
Connected ?
NO
YES
556
Retry ?
YES
562
Call initiated
NO
558
Inform caller
564
Call finished, close TCP connection
560
Hang -up
566
Hang -up

FIG. 6b

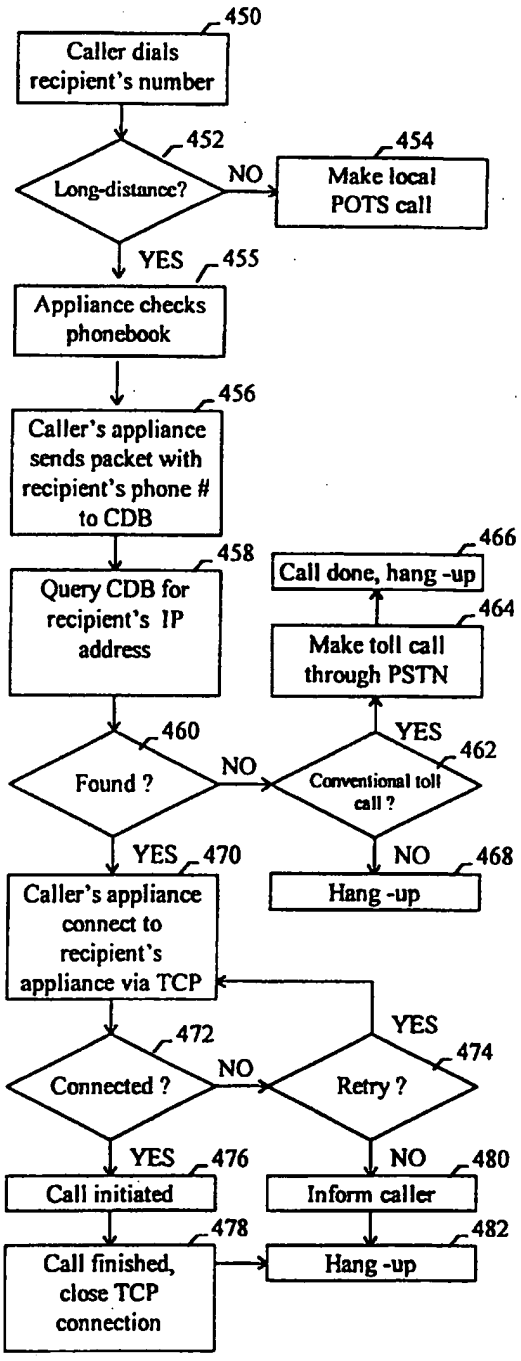
450
Caller dials recipient's number
452
Long-distance?
NO
454
Make local POTS call
YES
455
Appliance checks phonebook
456
Caller's appliance sends packet with recipient's phone # to CDB
458
Query CDB for recipient's IP address
460
Found ?
NO
462
Conventional toll call ?
YES
464
Make toll call through PSTN
466
Call done, hang -up
YES
470
Caller's appliance connect to recipient's appliance via TCP
NO
468
Hang -up
472
Connected ?
NO
474
Retry ?
YES
YES
476
Call initiated
NO
480
Inform caller
478
Call finished, close TCP connection
482
Hang -up

FIG. 7

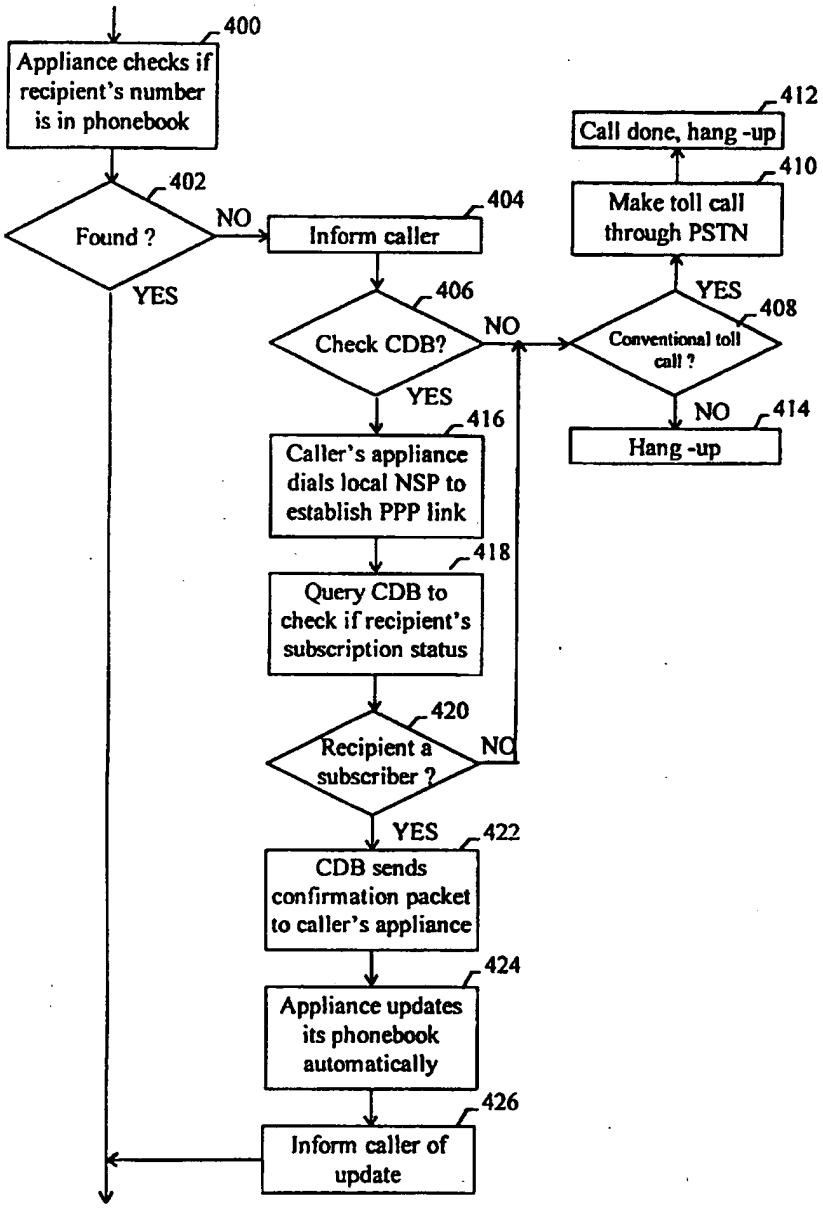
400
Appliance checks if recipient's number is in phonebook
402
Found ?
NO
YES
404
Inform caller
406
Check CDB?
NO
YES
408
Conventional toll call ?
YES
NO
410
Make toll call through PSTN
412
Call done, hang -up
414
Hang -up
416
Caller's appliance dials local NSP to establish PPP link
418
Query CDB to check if recipient's subscription status
420
Recipient a subscriber ?
NO
YES
422
CDB sends confirmation packet to caller's appliance
424
Appliance updates its phonebook automatically
426
Inform caller of update

FIG. 8

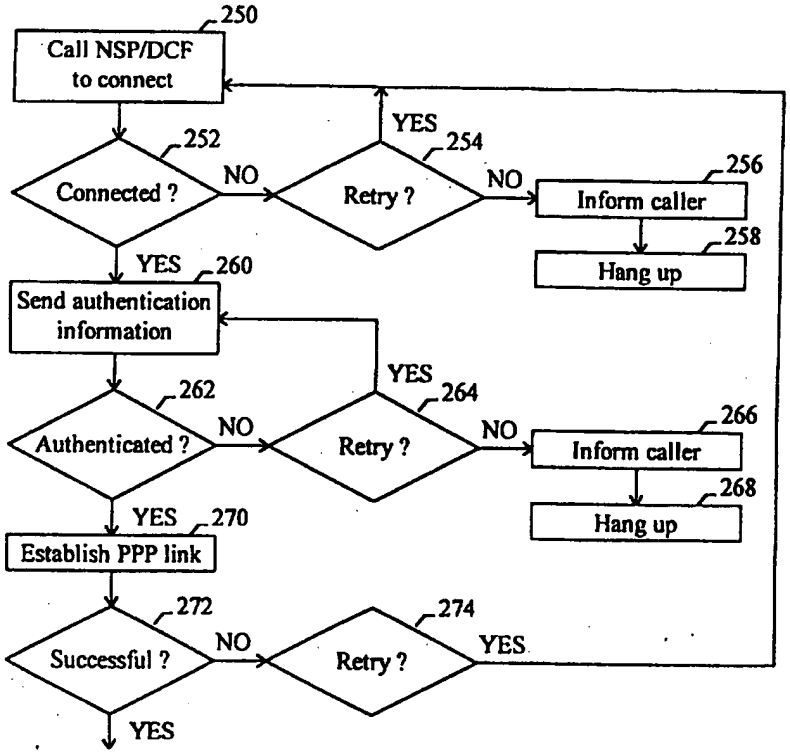
250
Call NSP/DCF to connect
252
Connected ?
NO
YES
254
Retry ?
NO
YES
256
Inform caller
258
Hang up
260
Send authentication information
262
Authenticated ?
NO
YES
264
Retry ?
NO
YES
266
Inform caller
268
Hang up
270
Establish PPP link
272
Successful ?
NO
YES
274
Retry ?
YES

FIG. 9

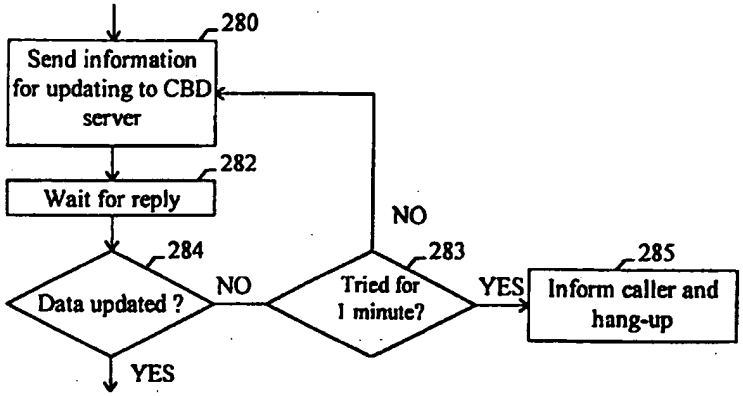
280
Send information for updating to CBD server
282
Wait for reply
284
Data updated ?
NO
YES
NO
283
Tried for 1 minute?
YES
285
Inform caller and hang-up

FIG. 10

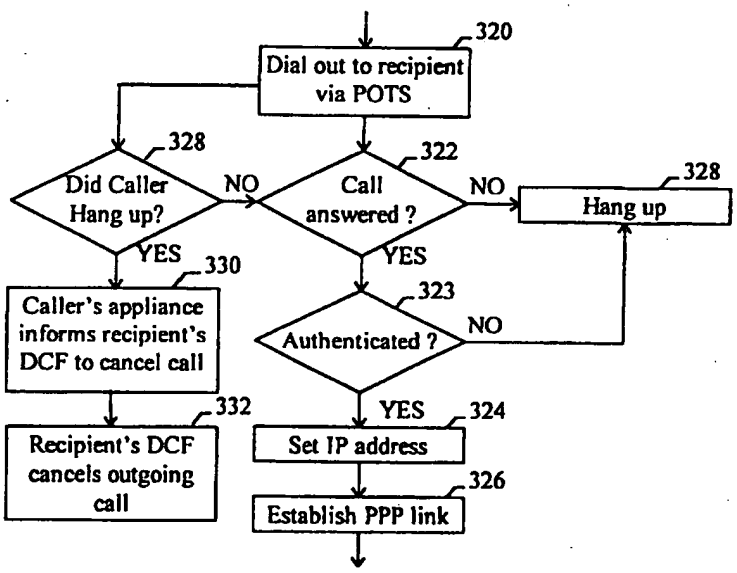
320
Dial out to recipient via POTS
328
Did Caller Hang up?
NO
322
Call answered ?
NO
328
Hang up
YES
330
YES
Caller's appliance informs recipient's DCF to cancel call
323
Authenticated ?
NO
YES
332
324
Recipient's DCF cancels outgoing call
Set IP address
326
Establish PPP link

FIG. 11

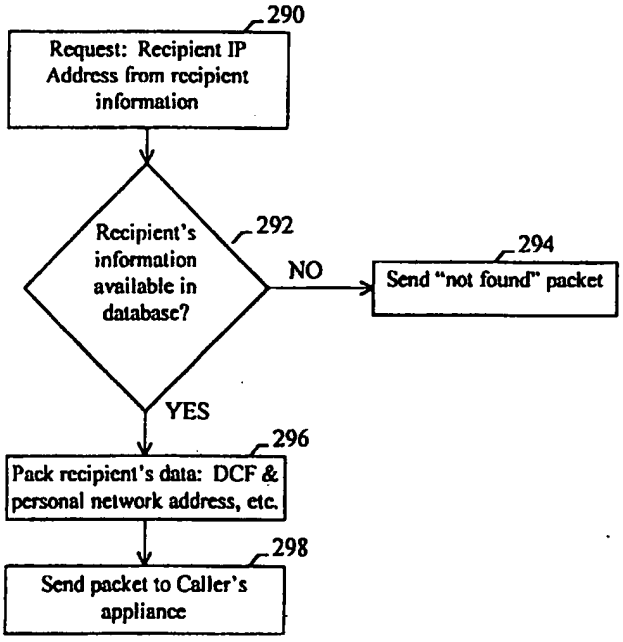
290
Request: Recipient IP Address from recipient information
Recipient's information available in database?
292
NO
294
Send "not found" packet
YES
296
Pack recipient's data: DCF & personal network address, etc.
298
Send packet to Caller's appliance

FIG. 12

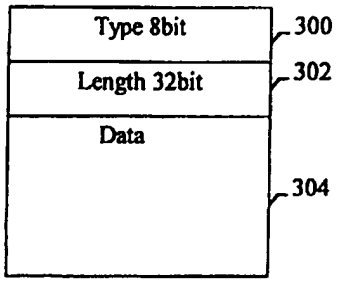
Type 8bit
300
Length 32bit
302
Data
304

FIG. 13

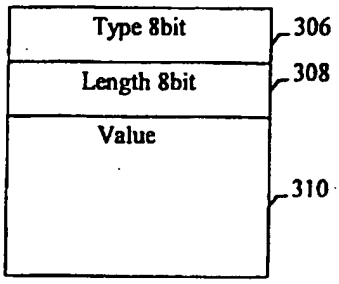
Type 8bit
306
Length 8bit
308
Value
310

FIG. 14